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Investment Opportunities in Oil and Gas in Alberta, Canada

DIANA
7 1988

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Investment Opportunities in Oil and Gas in Alberta, Canada

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Alberta — Rich in Oil and Gas

Introduction

Alberta, Canada, has long been known for the magnitude of its oil and natural gas resources — and for proven technology and innovation in their exploration and development.

Situated east of the Rocky Mountains and north of Montana, Alberta is one of Canada's largest provinces, encompassing an area of 255,000 square miles. Its mixed terrain includes the Rockies, vast grasslands in the south and forest in the north.

About 2.4 million people, or 10 per cent of Canada's population, live in the province. More than half reside in the cosmopolitan cities of Edmonton and Calgary. Edmonton, the provincial capital, is a commercial, governmental and oil refining centre. Calgary, a financial and commercial centre, is the location for over 600 head offices of energy and resource corporations.

A major oil discovery in Leduc, Alberta, in 1947 sparked the beginning of the province's modern oil industry. Most of the province overlies the Western Canadian Sedimentary Basin, the source of Alberta's oil and gas wealth.

The population of this young province, which was established in 1905, has tripled in the 40 years since the Leduc discovery. This growth is a result of rapid expansion in the oil and gas industry which has fuelled the provincial economy.

Investors find Alberta to be Canada's province of energy opportunity. The oil and gas industry is bouncing back from the lower oil prices of 1986, aided by reduced operating costs and a prompt and sensitive response by provincial and federal governments.

While finding costs vary widely, at present Canadian finding costs are about one third less per barrel than in the U.S.

The National Energy Program, which imposed severe restraints on the industry, has been dismantled. Provincial royalties on oil and gas were reduced in 1986, resulting in the lowest rates since 1974. Oil royalty holidays have been enhanced and extended.

Alberta is relatively young in terms of oil and gas exploration, and remaining oil and gas reserves are large.

The province has a long history of political stability. The Government of Alberta has strongly supported free enterprise for more than 50 years.

Strong growth years, moreover, have left Alberta with an extensive infrastructure of roads, pipelines, communications systems and serviced communitites.

Modern communications systems link every part of Alberta with the world. The province enjoys fine medical services, educational institutions and world-class facilities in science and technology.

The universities and technical schools are closely involved with the training of people entering the oil and gas industries. Computer time is available to industry at the universities. This includes use of the University of Calgary's Supercomputer, established to encourage research in leading-edge application software.

Calgary and Edmonton are ranked among the cleanest, safest cities in the world. They support a vibrant cultural life, including a film industry and performing arts.

The province's recreational facilities include Edmonton's acclaimed river valley park system, and, in Calgary, the legacy of the 1988 Winter Olympics. The Canadian Rockies are world-renowned.

Alberta has an abundant supply of that most vital resource, an educated work force. In this respect, Albertans lead the country. Thirty-seven per cent of the population had attained post-secondary education in 1986.

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About 1.6 million people — 68 per cent of the population — are in the major working age group between 15 and 64 years. This work force has a wide range of skills, including managerial and technical. Alberta is home to a large number of geologists, geophysicists and engineers with skills devoted to natural resource exploration and development.

The work force is both stable and competitive. Labor costs have moderated to the lowest levels in several years.

Today these factors make Alberta one of the most attractive sites in the world for oil and gas investment.

Alberta's Substantial Reserves

Alberta has been accurately described as the energy storehouse of Canada. The province provides about 85 per cent of total Canadian output of crude oil, natural gas and related products.

The province's remaining **established conventional crude oil*** reserves at the end of 1986 totalled approximately 4 billion barrels. This represents about 75 per cent of Canada's remaining established reserves of conventional crude oil. Alberta currently produces slightly more than one million barrels per day of crude oil and equivalent.

Alberta's Oil Sands are potentially the province's most important energy resource. They constitute one of the world's largest fossil fuel reserves.

The oil sands consist of a black, tar-like mixture of sand, clay, water and bitumen — a naturally occurring viscous mixture of hydrocarbons which in its natural state is not commercially recoverable through a well.

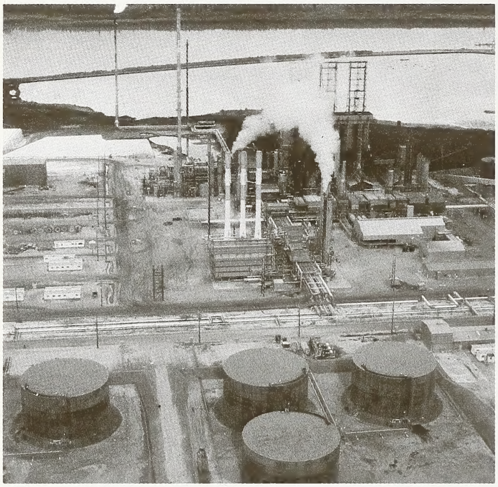
Ultimate recoverable reserves of bitumen are estimated at about 300 billion barrels. These reserves occur in strata which may be found on the surface or to depths of 2,000 feet. Almost 20 per cent of these reserves can be surface mined; the balance is recovered using in situ methods (those which recover the oil in place).

Two commercial operations today produce synthetic crude oil through surface mining of the Athabasca oil sands. (The term synthetic crude, to distinguish it from conventional oil, refers to oil extracted from the oil sands and upgraded to market quality.) As well, revolutionary strides are being made in technology to improve production and resource recovery, both by surface mining and by in situ methods. At Cold Lake, Esso Resources Canada Ltd. employs in situ techniques for large-scale commercial production.

Established reserves are defined as those reserves recoverable with current technology and under present and anticipated economic conditions, specifically proved by drilling, testing or production. Remaining established reserves for any year are the initial established reserves less cumulative production.

Remaining established natural gas reserves in Alberta totalled 61 trillion cubic feet (tcf) at the end of 1986.

Sulphur, a by-product of natural gas, is used primarily in the chemical and fertilizer industries.



The Feedstock Advantage, based on Alberta's assured supply of natural gas at market prices, forms the lifeblood of a world-scale petrochemical industry. The province is one of Canada's three main petrochemical-producing areas, along with Quebec and Ontario. The petrochemical industry is the third largest manufacturing sector in Alberta. Most growth in the province's petrochemical industry has occurred in the last 12 to 14 years.

Policy of Partnership in Development

The Alberta Government owns about 85 per cent of the province's mineral reserves, and leases mineral rights to the private sector for development.

Although development relies on the initiative of the private sector, Alberta has been prepared to be an equity participant in projects believed to be of long-term benefit. Syncrude Canada's large-scale oil sands operation, in which the province is one of several partners, is an excellent example of various levels of government and industry working together in a successful business endeavor.

Creating a healthy investment climate for energy is a provincial priority. Consequently, Alberta's legislation and policies for petroleum and natural gas are favorable to investors of every size. Policies affecting petroleum resources result from consultation between representatives of industry and government.

Benefits industry will find in Alberta include:

- A stable business environment
- A government committed to free enterprise
- Fair, structured operating conditions
- World-class data resources
- Highly trained and skilled manpower resource.

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The Role of the Alberta Government

Major Changes

Recent deregulation has brought major changes to Alberta's oil and gas industry.

A new and freer climate was ushered in with the Western Energy Accord. This federal-provincial agreement, signed in March 1985, removed controls on the pricing and marketing of crude oil and petroleum products.

The Western Accord was followed in October 1985, with the Agreement on Natural Gas Markets and Prices. This laid the foundation for the deregulation of domestic gas markets and created more liberal export conditions.

The major changes in gas pricing and marketing to date:

- Direct sales are now permitted between the producer and purchaser.
- More relaxed export conditions to the United States are now in effect. The surplus test, previously required by Canada's National Energy Board, has been significantly relaxed.
- Gas prices are now dependent on market forces; government price controls have been eliminated.

These changes represent major accomplishments. Progress is continuing in further deregulation.

Custodianship Role

From exploration to the collection of royalties, the Government of Alberta plays a role through various agencies in the management of the province's energy resources. The province has been responsible for Alberta's energy resources since 1930. Before that, natural resources were under the control of the federal government.

As custodian of oil, gas and mineral resources, the government's role is to set the broad framework for resource policy and regulation. This is achieved through various government departments and agencies:

Alberta Department of Energy

The provincial government's energy department is responsible for overall policy and management of energy resources. Its legislated mandate is to promote effective management of Alberta's energy resources, while by right of ownership it collects the provincial government's fair share of petroleum resource revenues through royalties.

Exploration and the Acquisition of Rights

The Mineral Resources Division of Alberta Energy leases oil, gas and other mineral rights to industry for development.

Geophysical exploration may be undertaken throughout the province by any recognized individual or company, without the need for the explorer to hold an agreement for oil and gas rights. In a few areas, however, such exploration may be prohibited for environmental reasons.

An exclusive agreement to oil and gas rights is required before exploratory drilling and development may take place. A nominal fee is charged for lease rentals, whether or not the area is producing.

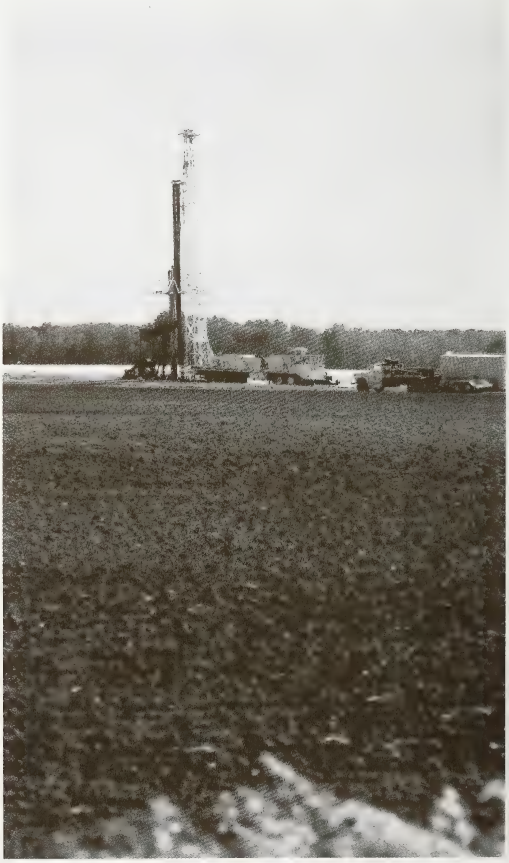
Acquiring Oil and Gas Rights — Directly or Indirectly

Investors have three ways of obtaining rights:

1. Direct lease, by obtaining an agreement for oil and gas exploration from the Mineral Resources Division of Alberta Energy through public tender. An individual or corporation wanting to acquire an agreement on a particular parcel of rights can request that it be posted at land sales held every two weeks in Calgary. Leases are awarded on the basis of a sealed bonus bid system.

2. Investors can negotiate farm-in agreements with companies which have already acquired oil and gas rights. Alberta now has almost 54,000 active conventional oil and gas agreements, held jointly or singly by about 2,000 companies.

3. Participate in a joint venture or equity purchase.



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Retention of Oil and Gas Rights

Leases are continued indefinitely at the end of their five-year initial term on the basis of their capability to produce; those rights which lie outside the limits of demonstrated pools, or below those pools, revert to the Crown in order that they may be made available for others to explore and develop.

Administration of Royalties

The government collects a royalty on all oil, gas and mineral production from lands leased by the province. Royalties are administered by the Department of Energy's Mineral Revenues Division.

Energy Resources Conservation Board

The Energy Resources Conservation Board (ERCB) operates under provincial legislation and receives half its funding from the private sector and half from the Alberta government. It is responsible for ensuring that Alberta's energy resources are developed in a safe, orderly manner that avoids waste, controls pollution and brings fairness and a sense of balance to the needs and concerns of the public, the government and the industry.

The ERCB ensures the safe development of Alberta's energy resources by setting the standards and specifications for energy development projects, through regulations and conditions included with project approvals. It also inspects operating sites and enforces the standards, specifications and conditions of approval. Before a potential oil or gas well is drilled, a well licence must be obtained from the ERCB.

The board, which has earned the respect of the industry through its technical expertise, maintains a vast data base giving the private sector access to more than 600 miles of core, 7.5 million vials of drill cuttings and many other related petrophysical and reservoir information.

Information from cores, cuttings and other items from exploratory wells is held confidential for one year, after which it is made public. Information from other wells is always public.

Alberta Oil Sands Equity

Alberta Oil Sands Equity manages the province's investment in the Syncrude Canada Ltd. project in an exploration and development program on six oil sands leases in northeastern Alberta.

The Alberta Petroleum Marketing Commission

The Alberta Petroleum Marketing Commission sells the province's share of crude oil obtained through royalties and, on request, acts as an agent for other producers. At the direction of the government, the commission markets the government's share of the synthetic oil production from the Syncrude project.

The Alberta Oil Sands Research and Technology Authority

The Alberta Oil Sands Technology and Research Authority (AOSTRA) is a provincial Crown corporation with a mandate to promote research and development of technology leading to efficient and economic recovery and processing of crude bitumen and other oil sands products.

Working in co-operation with industry, AOSTRA's involvement in technological development ranges from academic and institutional research to the support of large-scale field pilots and demonstration units. The development of technology for enhanced recovery from conventional light oil reservoirs was added to AOSTRA's mandate in 1980.

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Alberta's Oil and Gas Opportunities: A Closer Look

Low Finding Costs

Exploration and development costs for conventional crude oil in Alberta are significantly lower than in most other areas of Canada and the U.S., due largely to Alberta's favorable geology and infrastructure.

The average cost of finding a barrel of crude oil equivalent (which includes natural gas measured in terms of a barrel of oil) was $6 (U.S.)* in the latter part of 1987, according to a study by the Canadian Energy Research Institute.

Operating costs for crude ol production are also lower in Alberta than in most other parts of Canada and the United States, due to a well-defined infrastructure and a mature industry. The vast majority of conventional crude oil production remained viable at the lowest prices recorded in 1986.

In 1986, the success rate for exploratory oil and gas wells was 49 per cent. A rate of 80 per cent was achieved for development wells.

CONVENTIONAL CRUDE OIL: Canadians depend heavily upon conventional crude to supply transporation, industry and residential needs. On a per capita basis, Canadians are the largest consumers of energy in the world. About 35 per cent of Canadian primary energy demand is filled by crude oil.

Alberta's 1986 production of crude oil and equivalent amounted to 1.3 million barrels per day, 83 per cent of the country's oil production. About three quarters of this production is exported to other Canadian provinces and into the U.S. The balance is refined or consumed within Alberta.

Overall market prospects are excellent. The province's proximity to the large U.S. market ensures continued market growth. The free trade initiative between Canada and the United States confirms Canada's present policy in energy, which is based on world prices and essentially free markets within North America.

**U.S. dollar used throughout unless otherwise noted*

Alberta's extensive pipeline system covers more than 110,000 miles within the province, and is a vital factor in oil and natural gas prospects. Pipelines connect in all directions, supplying eastern Canada, part of British Columbia and a substantial part of the U.S.

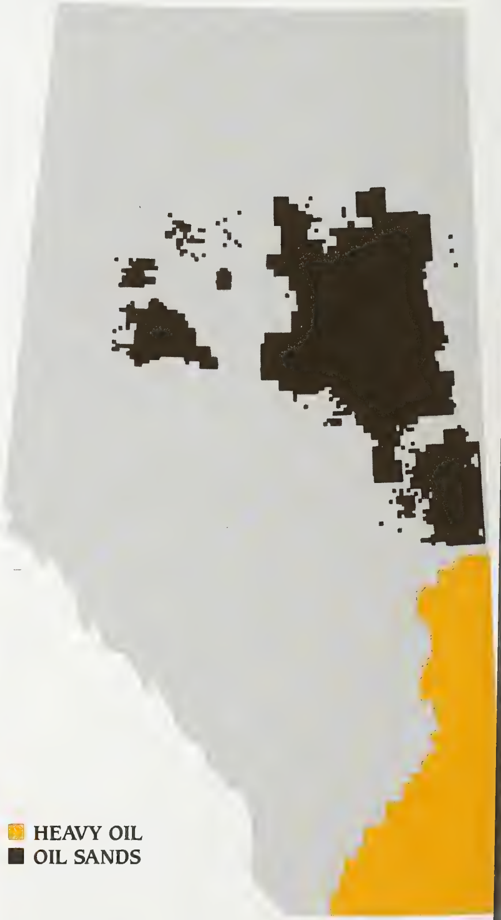
ENHANCED OIL RECOVERY: Alberta is a world leader in enhanced oil recovery (EOR) — the use of highly complex techniques to improve recovery rates from partially depleted reservoirs. Water injection, commonly referred to as secondary recovery technology, is the most common EOR method and is common practice in the Alberta oil fields.

Advanced or 'tertiary' recovery techniques, such as miscible floods, are also being employed. These involve injecting various hydrocarbon solvents into reservoirs to move the oil. Today more than 45 EOR projects, using miscible drive technology and varying in size and complexity, operate in the province.

The Government of Alberta is committed to the development and implementation of EOR projects. The principal provincial EOR program essentially reduces current royalties payable in exchange for future royalties from the incremental production derived from the miscible flood. This is termed "4.2 Relief" after the section of the Petroleum Royalty Regulations on which it is based.

HEAVY OIL: Heavy oil is thick and viscous. A major product of heavy oil is asphalt used for highway paving, shingles and roofing tar.

Remaining established reserves of conventional heavy oil in Alberta contain an estimated 300 million barrels. Only a small percentage, however, is recoverable by primary methods. Thermal projects are in operation which use and develop new technology to recover heavy oil.



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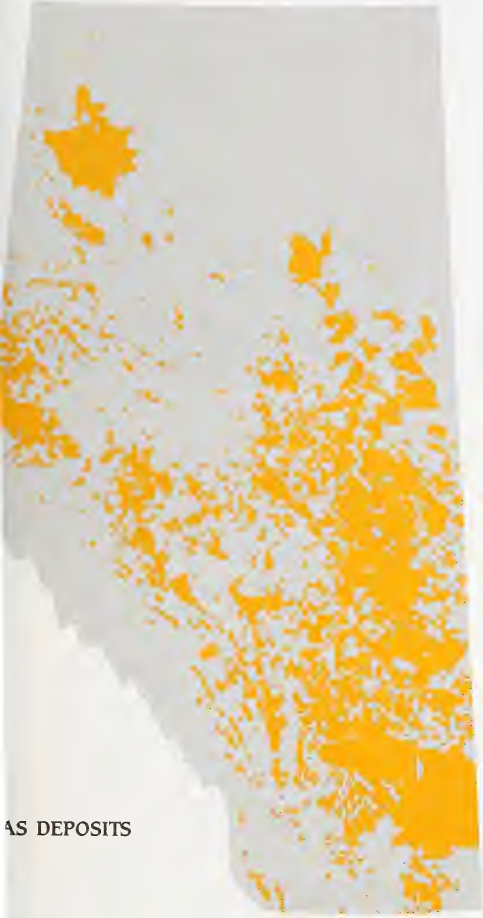
Most heavy oil is exported to the U.S. Midwest. Vith upgrading facilities to turn heavy oil into ghter conventional oil for refining, Alberta refineries vould be assured of a compatible feedstock as onventional light crude oil supply declines. Industry nd government interest in this aspect of energy evelopment is increasing.

NATURAL GAS: Alberta accounts for 86 per cent f Canada's production of natural gas. Production f natural gas ranged from 1.9 to 2.5 tcf per year hroughout the 1980s, and totalled 2.5 tcf in 1986.



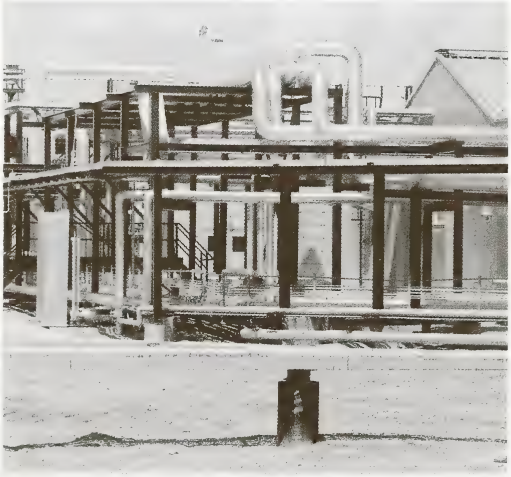
AS DEPOSITS

Approximately 75 per cent of Alberta's natural gas production is exported to eastern Canada and the U.S. The balance is used in Alberta for heating, generation of electricity and as petrochemical feedstock.

Market prospects look especially promising. As Canadian natural gas exports have become deregulated, Alberta producers have been able to price competitively in the key markets of California and Midwest states such as Illinois and North Dakota. Since Canadian deregulation was founded in October, 1985, new sales into the U.S. have been limited by the restrictions on pipelines by U.S. regulatory authorities. Although Canada currently supplies about four per cent of the total U.S. gas market, that figure is expected to increase soon as order returns to the market, U.S. pipeline restrictions are eliminated and the U.S. domestic production further declines.

Natural gas requires processing to separate various components, which can include ethane and other natural gas liquids, as well as methane, the natural gas used for most heating. Demand is on the upswing for natural gas liquids, used for a variety of purposes, including feedstock and dilution of crude oil in pipelines.

Sulphur, produced from the hydrogen sulphide removed from raw natural gas streams, is of growing importance. Alberta's sulphur is shipped world-wide and in 1986 accounted for about 45 per cent of the world's sulphur trade. The 1986 average world price for sulphur was $97/tonne; revenue to producers reached nearly $670 million.

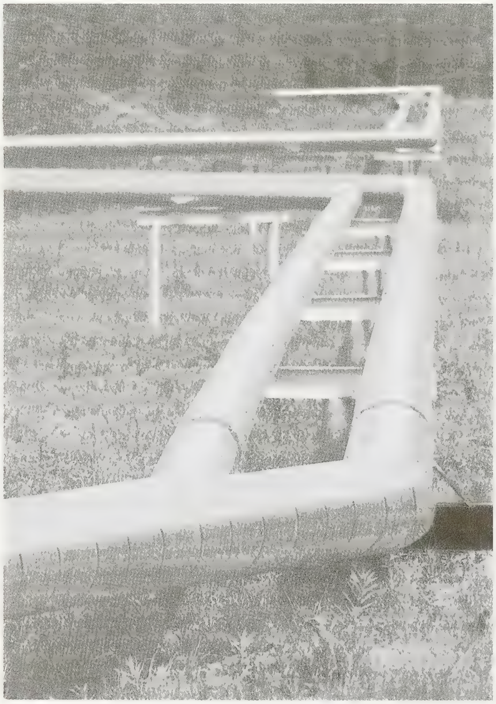


OIL SANDS: Oil sands development is progressing rapidly in terms of productivity, reliability and efficiency, both for surface mining and in situ extraction.

Suncor began the first commercial-scale oil sands venture in 1967, with a 50,000-barrel-per-day mining and upgrading facility. Two large oil sands mining operations, Syncrude and Suncor, now produce an average of 185,000 barrels per day of synthetic crude oil.

Although developing the oil sands remains a long-term investment, today's increased emphasis on advanced technology and synthetic fuels points the way to future opportunity.

Oil companies began experimenting with in situ techniques in the mid-1970s. Today there are several experimental and commercial projects of this type; about 100,000 barrels of bitumen (the term used for non-upgraded oil sands production) are produced commercially per day. Active research is lowering operating costs and increasing recovery factors, now in the 17 to 20 per cent range. Much of this research is sponsored by AOSTRA and is shared with the private sector.



New technology and smaller-scale concepts are reducing the initial capital requirements for these in situ projects, and increasing their attractiveness to investors. The 1987 announcement that Esso Resources Canada Ltd. will expand its Cold Lake development by almost 50 per cent is a significant sign of rising confidence.

The market for oil sands production is promising. Synthetic crude and bitumen output have risen rapidly over the last five years, with U.S. Midwest refiners taking the largest portion. Direct pipeline connections into Chicago position the province well to compete in this large market.

The drive to use new technology to reduce unit costs and improve reliability in surface mining is showing marked results. In 1987, Syncrude produced synthetic crude oil at a cost of $11 per barrel, compared to $19 per barrel in 1979. Recovery factors of up to 92 per cent are being attained for surface mines. These facts are a tribute to Alberta's skill in the extraction of high-quality oil from sands.

PETROCHEMICAL AND RELATED INDUSTRIES Petrochemical processes change the molecular structure of hydrocarbons. This results in chemicals which can be made into an array of essential consumer and industrial products for markets in the U.S., Japan, Korea and Europe.

In Alberta, ethane, a natural gas component, is the raw material used in the production of ethylene-based petrochemicals. The province's refining base includes two world-scale ethane cracking plants at Joffre. Ethylene is used in the manufacture of plastics, film and bags, anti-freeze, adhesives, paint textiles and many other items. In terms of ethylene derivative capacity, Alberta-based plants produce over 80 per cent of the nation's ethylene glycol, and one-third of its polyethylene.

Other chemical and fertilizer plants are situated in such areas as Fort Saskatchewan, Edmonton (Clover Bar), Prentiss, Scotford, Carsland and Medicine Hat.

Demand for Alberta feedstocks and refining capability is expected to grow at a modest rate. The industry is on competitive footing with other major petrochemical nations, largely due to Alberta's investment in new world-scale plants, its well-established infrastructure and experienced personne

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Government Programs

The Alberta and Canadian governments have sponded to world market events by enacting policies nd special programs to stimulate economic activity nd continue to promote effective use of resources.

As a result, net returns to oil producers in Alberta e roughly equivalent to 1985 levels, when prices ere much stronger.

ROYALTY RATE REDUCTIONS: In response to clining oil prices in 1986, royalty rates were duced by the provincial government and today are their lowest levels since 1974.

ROYALTY HOLIDAY PROGRAMS: These ograms encourage exploration for conventional oil d gas by allowing royalty-free periods of oduction for successful wells.

LBERTA ROYALTY TAX CREDIT: This program a selective Crown royalty reduction aimed at oviding small producers with additional cash flow.

NHANCED OIL RECOVERY: The government cognizes the high cost of enhanced oil recovery rough special royalty provisions.

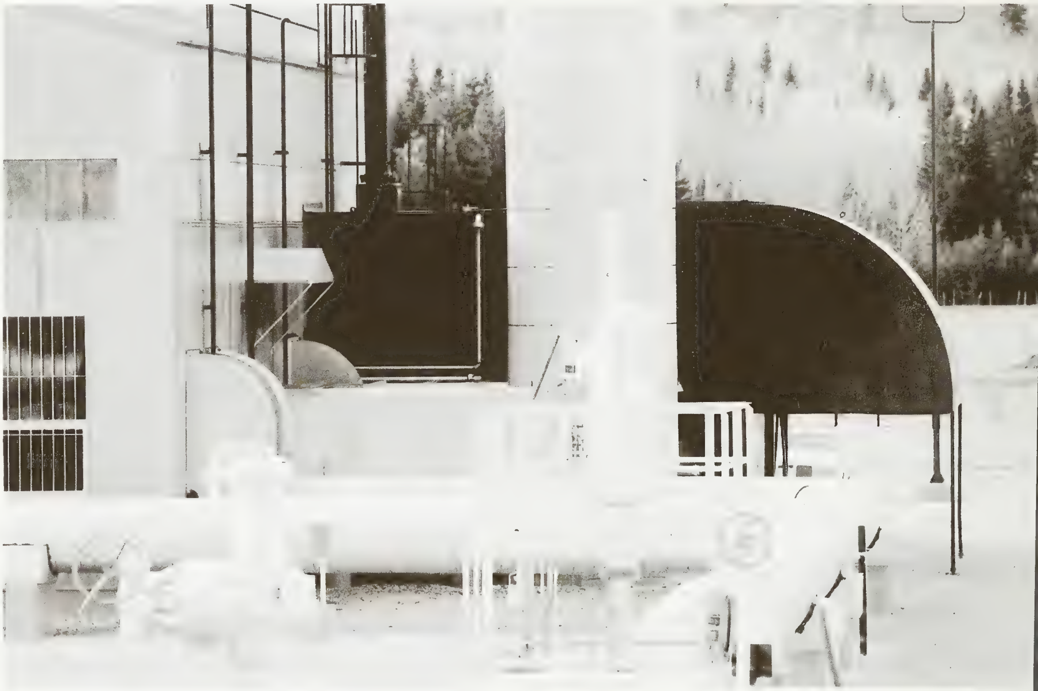
NON-CONVENTIONAL OIL PROJECTS: For non-conventional crude oil production from oil sands, the royalty structure is based on the concept of a nominal royalty until capital investment has been recovered, at which time a profit-sensitive royalty is triggered. This royalty regime is negotiated with the provincial government on an individual basis.

EXPERIMENTAL PROJECTS: New and innovative small projects qualify for experimental status. A low, flat royalty rate is levied on these projects.

Federal Government Assistance

A 1987 federal initiative, the Canadian Exploration and Development Incentive Program, provides producers with cash grants for a portion of the costs of new drilling and exploration up to $10 million of expenditure per firm per year.

Future Energy Prospects



The time is right for major development in the oil sands. Oil supply trends indicate declining production and rising prices for conventional light crude oil. Production of oil from oil sands has proven to be economically viable, and the industry is now ready for further development;

Alberta has the potential to emerge from the 1980s as a major North American participant in petrochemicals, with assured feedstock supply and private investment now in place.

Most of the industry's attention is at present focused on attractive oil and gas plays in the north and central portions of the province, where a number of recent discoveries have demonstrated the potential for prolific new reservoirs. The areas of Rocky Mountain House, Peace River-Grande Prairie and Caroline are especially active.

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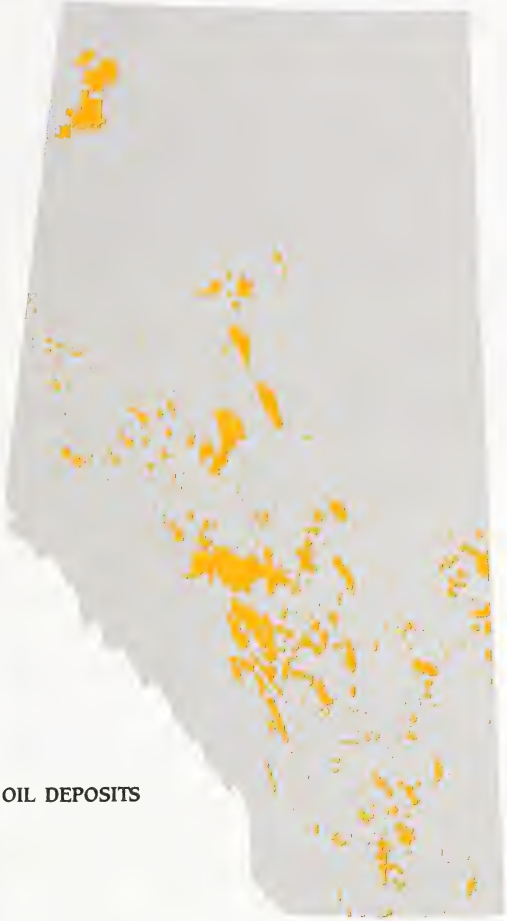
Favorable Investment Climate

The potential investor will find in Alberta:

- Potential for significant discoveries*
- Proximity to the U.S. market
- A stable and attractive fiscal regime
- Low finding, labor and operating costs
- A stable political climate which encourages free enterprise and foreign investment
- An extensive infrastructure of roads, pipelines and services
- Affordable, available industrial land
- A world-class data base in the ERCB
- An open, competitive bid process for oil and gas leases

(In 1986, for example, a gas field with estimated reserves xceeding 2 trillion cubic feet was discovered in a well-xplored area of central Alberta.)



OIL DEPOSITS

For More Information

Two provincial government departments provide assistance to the resource sector. The Department of Energy oversees the province's resources, while Economic Development and Trade helps to stimulate economic diversification and growth in the private sector. Among its many functions, the latter provides counselling and site location assistance to companies wishing to locate in Alberta.

Alberta Energy/Forestry, Lands and Wildlife
Information Centre
Main Floor, Bramalea Building
9920 - 108 Street
Edmonton, Alberta
T5K 2M4
Telephone: (403) 427-3590

Listing of Alberta Trade Offices Outside Canada

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Conventional Oil

Oil Sands

Coal

Natural Gas

Petrochemicals

- Alberta's oil and gas resources form the basis of Western Canada's leading petrochemical industry. Using oil and natural gas as major raw materials, thousands of industrial and consumer products are produced, everything from plastics and fertilizers to detergents and dyes.
- Alberta's substantial supplies of attractively-priced oil and gas led to major petrochemical developments during the 1970s and the early 1980s.
- The province's petrochemical industry is the leader in Western Canada.
- The petrochemical industry can basically be broken down into two divisions — the primary industry which produces basic chemicals from oil and gas, such as ethylene for use by other industries, and secondary industries which convert basic petrochemicals into secondary products.
- Some pipelines take the raw materials to refineries and processing plants. Others take the finished product to markets.
- Petrochemical companies in Alberta turn out a wide range of both primary and intermediate products. Ethylene, one of the most versatile petrochemicals, is used in the manufacture of plastics, film and bags, anti-freeze, adhesives, paints, textiles and many other items.
- Major chemical and fertilizer companies with plants in Alberta include Dow Chemical, Celanese, C.I.L., Union Carbide, Shell Chemical Canada, Sherritt Gordon and Novacor Chemical.
- Alberta's petrochemical industry produces more fertilizers, mostly of the nitrogen-type, than any other province.
- Between 40 and 60 per cent of the fertilizers produced in the province are consumed in Western Canada, with the balance exported.

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Conventional Oil

Oil Sands

Coal

Natural Gas

- Alberta has 85 per cent of the recoverable, or economically viable, conventional natural gas reserves in Canada.
- Alberta is Canada's largest producer of natural gas, accounting for 89 per cent of Canada's total production in 1986.
- Established natural gas reserves in Alberta total 62 trillion cubic feet (tcf) and would last 26 years at current production levels.
- Natural gas is a mixture of hydrocarbons, predominantly methane, which exist in a gaseous state at ordinary temperatures and pressures.
- It is created under conditions of extreme heat by the decomposition of organic material in sedimentary rocks and by the transformation of oil and other hydrocarbons.
- Gas was not used commercially to any extent in Alberta until after 1900, although the history of the Canadian natural gas industry really commences with the Leduc oil discovery of 1947.
- By the 1920s, natural gas was being successfully marketed as a residential fuel in Edmonton and Calgary.
- The earliest gas processing simply separated hydrogen sulphide and condensate from the gas stream.
- Today, the province has more than 400 processing plants and more than 18,000 known gas reservoirs.
- Alberta has always had the potential to produce more natural gas than it requires. Roughly 70 per cent of Alberta's production is exported to other provinces and to the U.S.
- Alberta's natural gas provides methane for use as a heating fuel and as a petrochemical feedstock. Natural gas liquids such as propane and butanes, and substantial amounts of ethane, are used in the production of ethylene-based petrochemicals.
- Natural gas is also used for the generation of electricity, although current Alberta policy is that no more natural gas is to be used for this within Alberta as there is ample sub-bituminous coal.
- Natural gas components are separated and liquefied through modern processing, which removes hydrogen sulphide and other impurities.
- Elemental sulphur, produced as a byproduct of sour gas processing, is another valuable resource for Alberta.

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Conventional Oil

Oil Sands

Coal

- Alberta's coal resources are immense. They are estimated at 2,600 gigatonnes (a gigatonne is one billion tonnes), with 800 gigatonnes considered to be potentially recoverable.
- There is enough coal in Alberta to keep the province's existing coal-fired plants, which produce electricity, supplied for 1,100 years.
- Coals are classified by 'rank,' a measure of heat value. In descending order of heating values, Alberta coals are ranked as semi-anthracite, bituminous, subbituminous and lignite. The rank is determined by the amount of fixed carbon, which is the source of the heat, and by the presence of other properties that affect coal quality and end use.
- Alberta's coal deposits are found in three distinct regions — the mountains, the foothills and the plains.
- The ranks of coals found in these areas are as follows:

  Mountain Coals — Low to medium-volatile bituminous i.e. low in moisture and ash. Converted to coke they are suitable for steel making.

  Foothills Coals — High-volatile bituminous primarily used in thermal electric generation. Also some medium to low-volatile bituminous.

  Plains Coals — Subbituminous coals. Burned in mine-site thermal generating plants or used as residential or commercial fuel within Alberta. Also some high-volatile bituminous.
- Although semi-anthracite and lignite coals are found in Alberta, they are not commercially mined at present.
- The first recorded coal mine started in 1874 on the banks of the Oldman River below Lethbridge. It was followed during the 1800s by the opening of mines in the Canmore, Medicine Hat and Edmonton areas.
- Mines at first employed underground room-and-pillar methods, but strip mining became more popular in the plains area after 1910.
- Coal enjoyed widespread use until the early 1950s, when it was almost entirely replaced by oil and gas for domestic heating, industry and transportation.
- The resurgence of coal began in the early 1970s, when its importance for electricity generation became evident.
- At the same time, demand for coking coal in Japan led the way to development of two bituminous steam coal mines in the foothills.
- Steep increases in oil prices in 1973 increased the need for coal for purposes other than steel-making. Overseas demand for coking coal grew as well as the demand in Alberta for thermal coal for electricity generation.
- Alberta, today, supplies 41 per cent of Canada's total coal production.
- Seventy-one per cent of Alberta's coal is used for electricity production in the province, 23 per cent is exported and the remainder sold elsewhere in Canada.
- Almost all of the subbituminous coal is used in Alberta.
- Alberta bituminous coals are shipped overseas from three marine terminal facilities in British Columbia, two in or near Vancouver and the third at Prince Rupert.

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Conventional Oil

Oil Sands

- Massive oil sands underlying 60,000 square kilometres (approximately 23,200 square miles) of Alberta contain one of the world's largest known reserves of recoverable oil.
- Northern Alberta's oil sands consist of a black, tar-like mixture of sand, clay, water and bitumen. Bitumen is a naturally occurring viscous mixture of hydrocarbons which in its natural state is not liquid enough to flow to a well without external stimulation; for example, injecting steam to make it less viscous.
- The oil sands are partially exposed along the banks of the Athabasca River, north and south of Fort McMurray in northeastern Alberta.
- They were noted in the journals of Peter Pond, Alexander MacKenzie and David Thompson in the 1700s.
- Early this century, some Edmonton streets were paved with oil sands, and asphalt manufacturing continues to be an important market for bitumen today.
- Long before Alberta was a province, Indians in northeastern Alberta used heavy black tar from the banks of the Athabasca to seal seams in their canoes.
- Today it is known that oil sands are primarily concentrated in four major deposits: Athabasca, Cold Lake, Peace River and Wabasca.
- Mineable deposits — those which lie under approximately 77 metres (about 250 feet) or less of overburden — cover approximately 3,250 square kilometres (about 1,250 square miles), over seven per cent of the total area of the Athabasca oil sands deposit.
- The Syncrude and Suncor mining operations extract the bitumen from the oil sands and upgrade it to synthetic crude oil. In 1987 synthetic crude accounted for about 14 per cent of all crude oil and equivalent produced in Alberta.
- In 1967 the Great Canadian Oil Sands (GCOS) project, now Suncor, became the first oil sands mining operation in the Athabasca region.
- Oil sand is actually removed, or mined, from the ground at the Suncor or Syncrude sites and the bitumen is then extracted. Bitumen is subsequently upgraded into synthetic crude oil and the land is reclaimed.
- The Syncrude oil sands recovery project near Fort McMurray is the biggest in the world. Built at a cost of $2.3 billion, it began operations in 1978, and is a consortium of corporate and government investors.
- Ultimate recoverable reserves of bitumen are estimated at about 300 billion barrels, but that amount represents only about 25 per cent of the total oil sands resource. The remainder is not recoverable under present technology.
- "In Situ" (Latin for "in place") is the other basic recovery method for oil sands deposits.
- For in situ projects, special techniques are used to release the bitumen from the sand while it is still in the ground. The heavy oil is heated in place to reduce its viscosity, then it can be pumped to the surface by regular drilling methods.
- Esso's Cold Lake project and the BP/Petro-Canada Wolf Lake project are examples of in situ techniques.
- Seventy per cent of the world's expenditures on oil sands are made in Alberta.
- The technology to commercially produce synthetic crude oil from oil sands is a new and uniquely Canadian industry. Eventually, this technology may permit recovery of enough synthetic crude oil to overtake conventional crude oil in importance.
- In terms of geological potential, almost 90 per cent of Canada's total remaining unexploited oil resource base is estimated to be bitumen from Alberta's oil sands.

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Conventional Oil

- Alberta is richly endowed with oil, gas, coal and mineral resources.
- The province overlies the Western Canadian Sedimentary Basin where thick beds of ancient rock contain abundant deposits of oil, natural gas and coal.
- Alberta produces most of Canada's conventional oil and natural gas.
- Significant oil and gas development did not occur until a major discovery of oil at Leduc in 1947.
- Alberta's remaining established conventional crude oil reserves at the end of 1986 totalled approximately four billion barrels — about three quarters of overall remaining Canadian reserves.
- Alberta refineries processed about 285,000 barrels of crude and equivalent per calendar day in 1986. This is just over 20 per cent of total Alberta production of crude and equivalent. The remainder was shipped to other Canadian provinces (about 45 per cent) and the U.S. (about 35 per cent).
- Crude oil processed in Alberta itself is converted into motor gasoline and diesel fuel. This accounts for about 70 per cent of all refined products made in Alberta.
- Jet fuel represents another seven per cent of total refined products. Remaining products processed here are aviation gasoline, kerosene, light and heavy fuel oil and lube oils.
- Finding conventional oil reserves can be difficult and expensive. About half of Alberta's conventional oil production comes from just 25 major pools.
- In the future, conventional oil production volumes will decline, while oil sands, coal and natural gas will become more prominent as energy sources.
- The reduction in conventional oil reserves is spurring efforts to find new reserves and to improve production from existing fields. Coaxing additional oil out of a depleted reservoir involves **enhanced oil recovery** (EOR) methods.
- EOR ensures that the maximum amount of crude oil is recovered from reservoirs. Most EOR projects involve injecting water or gas into the formation to force the oil out of the rock.
- An important type of EOR operation receiving increasing attention is the injection of a solvent, such as ethane, propane or carbon dioxide, to flush the oil from the small pore spaces in the rock. This is called a miscible flood.

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